RIVERINE ASSESSMENT USING MACROINVERTEBRATES:
ALL METHODS ARE NOT CREATED EQUAL

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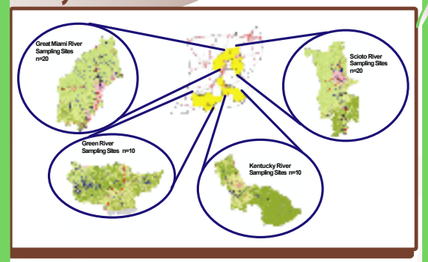
Project Objective:

Provide states, regions, and tribes with guidance on the sampling of benthic macroinvertebrate assemblages of large rivers for bioassessment purposes.

Study Area:



Field Methods:

Reviewed protocols of several agencies and selected 6 to emulate in this study.

Active Sampling Methods

KN — **Kick-Net (Semi-Quantitative; Single Bank).** Two 20-second kicks (595-µm net) at 11 evenly-spaced transects over a 2000m distance.

RTH — **Targeted Habitat 1000 m (Semi-Quantitative; Both Banks).** Sampled 5 or 6 areas of richest-targeted habitat (rocks, snags and macrophytes) of a 1000m reach using a dip net (425-µm)

DP500 — **Dip-Net/Pick 500 m (Qualitative; Both Banks).** Sampled all available habitat types over a 500m distance using a dip net (595-µm).

DP1000 — **Dip-Net/Pick 1000 m (Qualitative; Both Banks).** Sampled all available habitat types over a 1000m distance using a dip net (210-µm).

Passive Sampling Methods

DN — **Drift-Net (Quantitative).** Two drift nets (595-µm) deployed during daylight for a four-hour period.

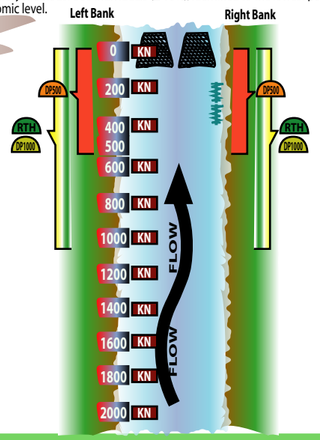
HD — **Hester-Dendy (Quantitative).** Five Hester-Dendy multi-plate samplers deployed for six weeks.

Field Results:

- Six benthic macroinvertebrate methods attempted at each of 60 sites.
- Total benthic macroinvertebrate samples collected = 334.
- DN samples not collected at 21 sites due to lack of flow
- HD samplers lost from 5 sites.
- Physical habitat and chemistry data collected at all 60 sites.

Laboratory Methods:

Laboratory Methods: 300 individuals (± 10%); identified to the lowest possible taxonomic level.



Step 1: Characterization of Sites

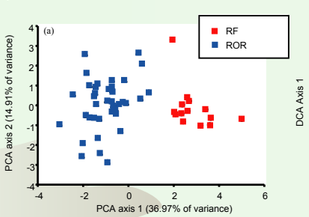
Two general types of sites were sampled.

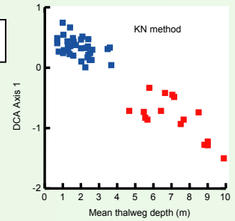
- Run-of-the-River (ROR): Free-flowing sites or with small low-head dams that store rather than regulate waters. Generally < 4m deep (N=31).
- Restricted Flow (RF): Sites heavily influenced by navigational Lock-and-Dam structures built to support commercial traffic. Generally > 4m deep (N=18).

We described differences between the two types of sites using two multivariate techniques.

principal Components Analysis (PCA) using:
mean thalweg depth
range of thalweg depth
mean wetted width
bank full height
mean temperature
number of substrates
percent gravel
percent cobble and larger
percent sand

Detrended Correspondence Analysis (DCA)
using macroinvertebrate genera (Kick-net method)



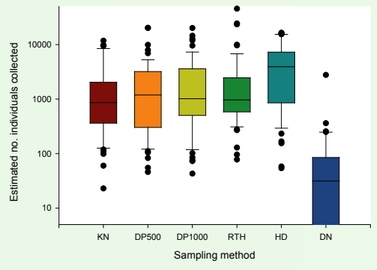


Results:

Mean thalweg depth was the most important physical factor on the first PCA axis, this largely being a consequence of degree of impoundment.

Macroinvertebrate assemblages differed between Run-of-the-River and Restricted Flow sites, strongly by depth.

Step 2: Did all methods collect sufficient numbers of organisms?



Results: The DN method consistently collected insufficient numbers of organisms for our purposes.

Implications: DN samples were excluded from further analysis.

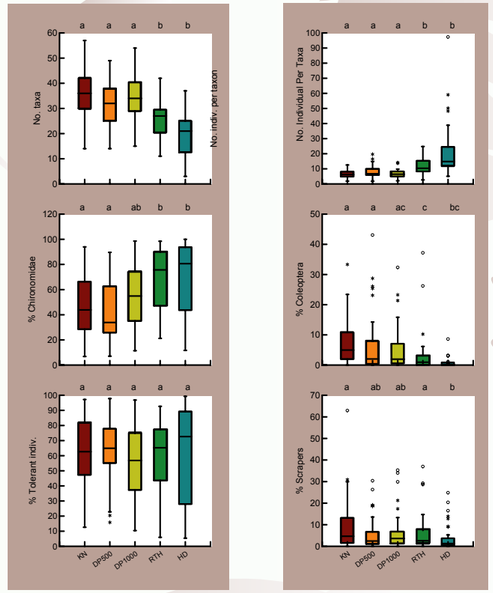
Step 3: Comparison of Methods

Did the metric scores vary by collection method?

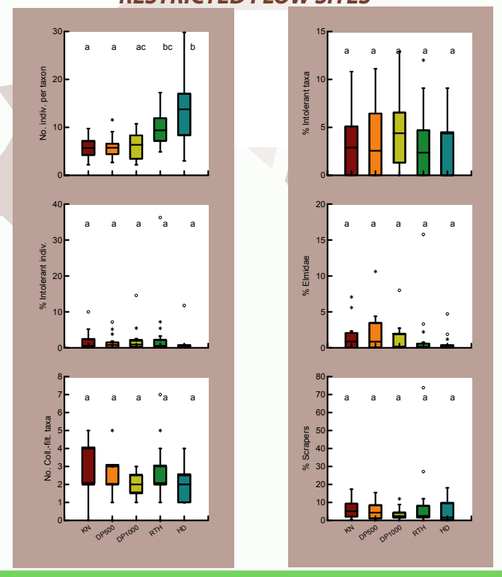
Metrics included on poster:
- Exhibited a range in deep and shallow sites
- Among those correlated with the most abiotic stressors

Analysis:
- Non-parametric repeated measures ANOVA used to compare methods.
- Letters at top of graphs indicate multiple comparison groupings

RUN-OF-THE-RIVER SITES



RESTRICTED FLOW SITES



Was the metric response to stressors consistent across methods?

Significant Spearman correlations ($p \leq 0.05$) between metrics and abiotic variables. Positive (+), negative (-), and non-significant (0) correlations are listed in the following order of methods : KN-DP500-HD-DP1000-RTH. For example, +0+00 indicates non-significant correlations between **number of taxa** and **% canopy density** for the DP500, DP1000, and RTH method significant positive correlations for the KN and HD methods.

Run-of-the-River sites:

Metric	Riparian Disturbance All Types	Riparian Disturbance Non-Agriculture	Riparian Disturbance Trash/ Landfill	Natural Fish Cover	% Canopy Density	Cobble and Larger	Large Woody Debris Volume	Large Woody Debris Quantity	Mean Conduct-ivity	SO_4	Cl	NH_4	TKN	Total P	TSS
Number of taxa	00-00	00-00	00-00		+0+00		0000+		0000-						
Number indiv. per taxon	+0+00	+0+00	0+++00		---00		0000-		000+0			00+00	00-00		
% Chironomidae Individual	00+00	00+00	00+00		-0000		0000-	0000-				-0000			
% Coleoptera Individual						+00+0	+0+0	+++0++	0-000	--0--			+0000		000-0
% Tolerant Individuals	00+0+	00+0+	00+00				--0--	-000-	+0000						0+000
% Scrapers					00+00	++0+0	+00+	000++		-00--		00+00			0-000

- Except for % Tolerant individuals, HD metric values differed from other methods, particularly the KN and DP500 methods.
- Even though some methods had similar metric values, correlations with abiotic variables often differed greatly among these same methods.
- The HD method was associated with physical habitat variables most often.

Restricted Flow sites:

Metric	Riparian Disturbance Agriculture	Riparian Disturbance Non-Agriculture	Riparian Disturbance Trash/ Landfill	Natural Fish Cover	% Canopy Density	Large Woody Debris Volume	Large Woody Debris Quantity	Mean Conduct-ivity	SO_4	Cl	NH_4	TKN	Total P	TSS
Number Indiv. per taxon					-0000		-0--0			0+000				
% Elmidae Individual					0+000	0+0+0	0+0+0							
% Taxa as Intolerant	0000-	000+0	000+0						000+0				00-00	
% Intolerant Individual		000+0	000+0	0000-				000+0	000+0		0000-		00-00	
No. Collector-Filterer Taxa					0+000			000-0	000-0					
% Scrapers	-0000			00--0	00++0	00+00						00-00		

- There were few differences among methods, except for individuals per taxon, which tended to be higher for the HD and RTH methods relative to the KN, DP500, and DP1000 methods.
- The metrics associated with the DP1000 method were most often associated with abiotic variables, although metrics based on the other methods were also associated with at least one abiotic variable.

Conclusions:

Methods Matter:

- Different field methods often result in different metric values.
- Performance of methods was not consistent between site classifications.
- Even when metric values were similar, correlations with abiotic stressors differed across methods.
- Merging data indiscriminately across field methods is not advised for bioassessment.

Outcome of this Research:

After comparing the currently available collection methods, the need and opportunity to craft a more stable and repeatable sampling method specifically designed for large rivers was recognized. During the summer of 2001, a new collection method was field tested. The new method, Standardized Assessment Method [S.A.M.] for Riverine Macroinvertebrates, combines the positive features of preceding methods and reaches a compromise between subjectivity and systematic random sampling. Progress on this research is featured on an accompanying poster.

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